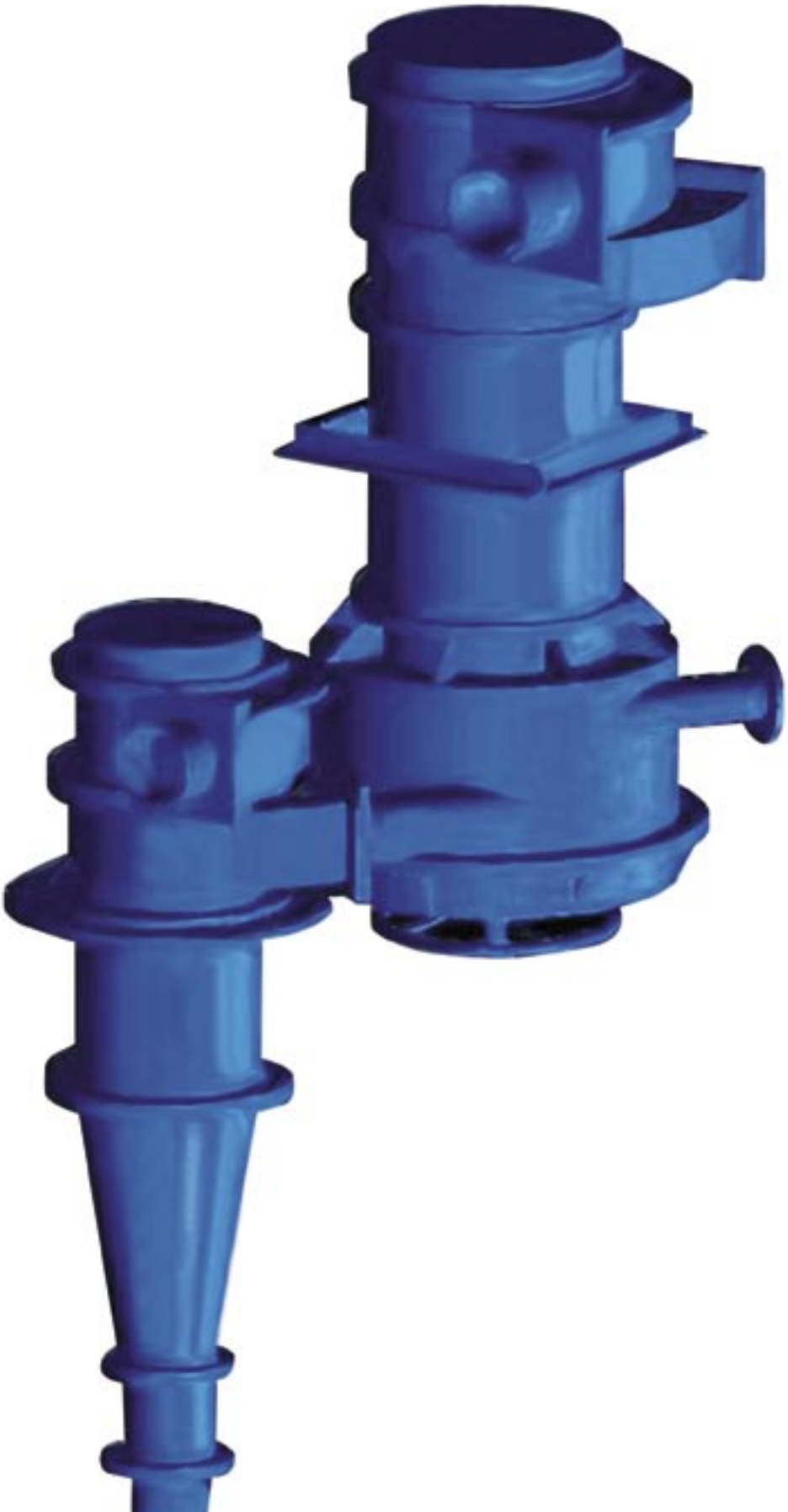
CAVEX®

ReCyclone

Slurry
Equipment
Solutions

WEIR MINERALS

Two-stage classification in one unit



Cavex® ReCyclone

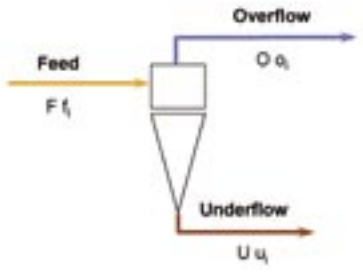
For many years Weir Minerals have applied their experience of slurry handling technology in the design and manufacture of hydrocyclones.

Single versus two-stage classification

In all cyclones there is a bypass of fine material to the underflow. The fine particles behave like water molecules and escape with the water that exits the cyclone underflow stream.

Because of this imperfect separation, two cyclones in series produce a significantly higher classification efficiency than a single cyclone.

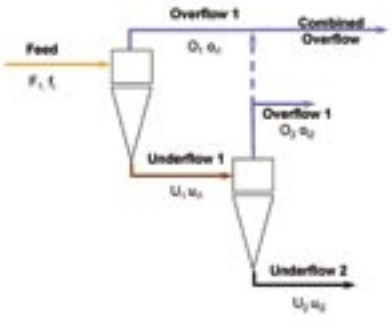
Single-stage classification



F, U, O: Solids flowrates
f_i, u_i ,o_i: mass fraction of each size range
Classicifaction efficiency, $E_i = Uu_i / (Ff_i)$

For example:
- for a cyclone operating at U/F = 75%
- 30% of the cyclone feed passes 38 micron i.e. f_i = 30%
- with say E_i = 20%
- $u_i = E_i F f_i / U$
  = 0.2 x 0.3 / 0.75 = 8%

Two-stage classification



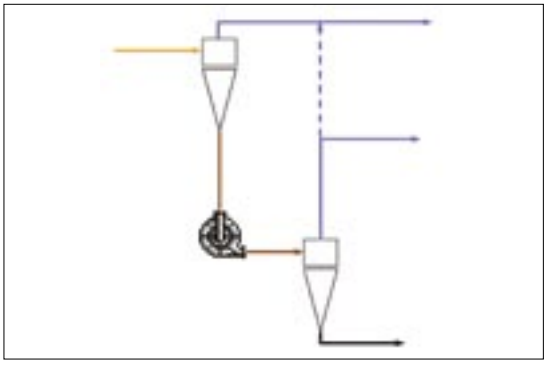
The overflow from both cyclones can be combined or treated separately.

Equations: $F = U_2 + O_1 + O_2$
$F_1 f_{1i} = U_2 u_{2i} + O_1 o_{1i} + O_2 o_{2i}$
First stage: $E_1 = U_1 u_{1i} / (F_1 f_{i1})$
Second stage: $E_2 = U_2 u_{2i} / (U_1 u_{1i})$
Overall: $E_T = U_2 u_{2i} / (F_1 f_{i1}) = E_1 \times E_2$

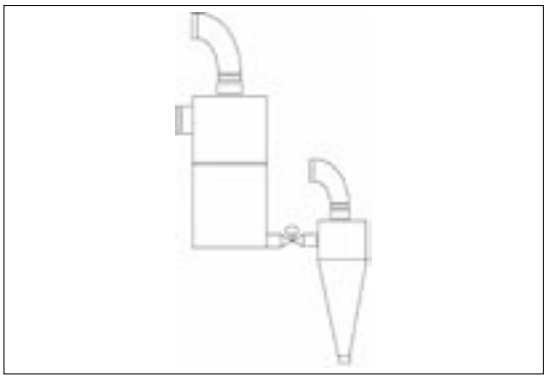
For the previous example for the -38 micron fraction:
- assume both cyclone operate at $U_1/F = U_2/U_1 = 75\%$
- as above, f_i = 30% and u_{i1} = 8%
- with $E_1 = E_2 = 20\%$
- $u_{i2} = E_2 U_1 u_{i1} / U_2$
  = 0.2 x 0.08 / 0.75= **2.1%**

The fines content in the underflow is almost a quarter of that for a single stage cyclone.

The traditional two-stage arrangement is to have an inter-stage pump between 2 cyclones (as shown below). However, the associated operating costs are high and this arrangement is not often used in industry.

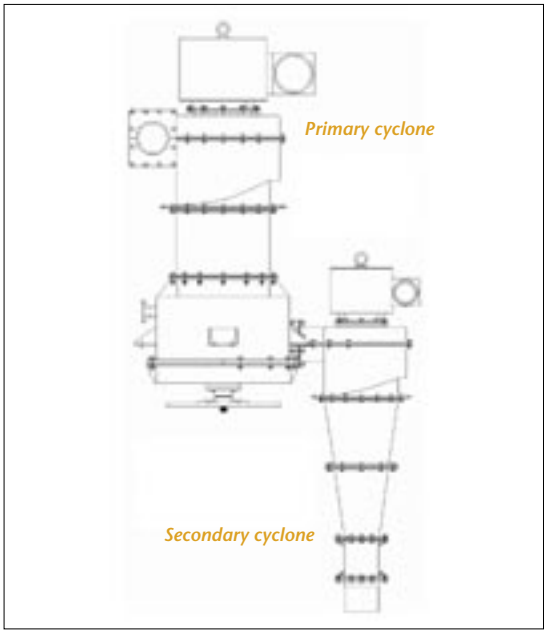


Several attempts have been made in the past to combine two-stage classification into one unit. However, these designs had common problems including high wear in the transfer zone, poor control over the flow split to the secondary cyclone, and the need to operate at high pressures.



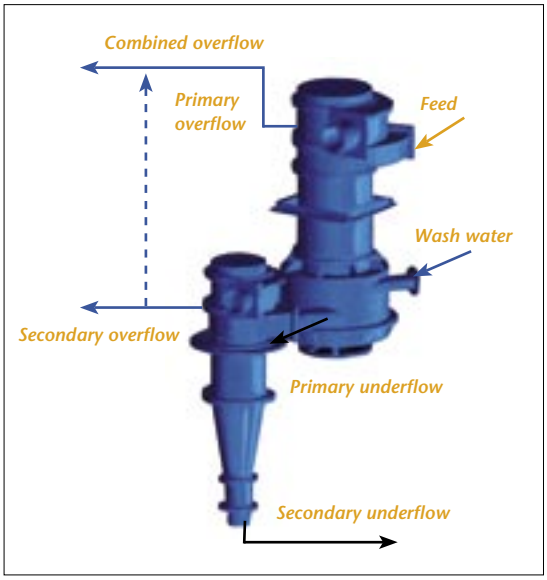
Weir Minerals has re-engineered this design and this is a significant improvement on previous design attempts, with a well-proven track record.

The ReCyclone consist of a primary cylindrical cyclone with the underflow stream directly coupled to a secondary cylindrical-conical cyclone.



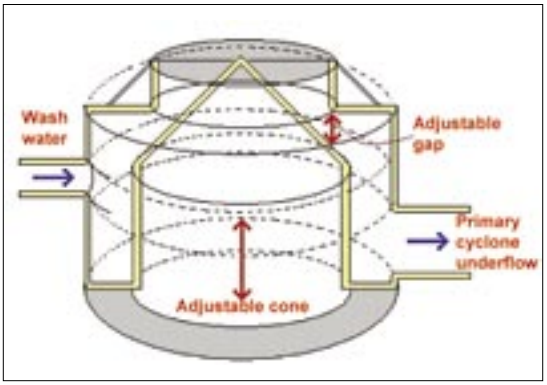
Flow regime around the ReCyclone

The feed enters the primary cyclone and its underflow flows into the secondary cyclone.



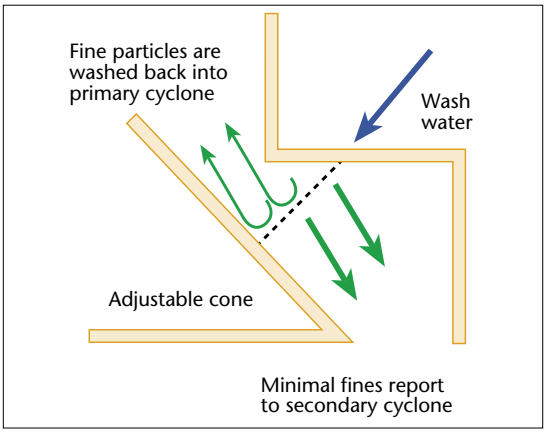
Interface between primary and secondary cyclones

The bottom of the primary cyclone consists of a cone within a cylindrical housing. The gap between the cone and the housing acts like a spigot. The cone can be moved vertically to adjust this gap. It can be used to optimise the flow split to the secondary cyclone.



When slurry is fed to a cyclone, fine material is entrained in the viscous layer of fluid formed close the cyclone wall.

Wash water is injected at the bottom of the primary cyclone. This water mechanically disrupts this viscous layer and also reduces its viscosity. The fines are freed from the viscous layer and have a second opportunity to be classified. The wash water thus significantly reduces the fines bypass to the underflow.



The reduction in viscosity also improves classification efficiency in the secondary cyclone.

These effects have been verified in actual plant operations.

The ReCyclone is a substantial improvement on previous two-stage cyclone design attempts.

The innovative adjustable cone design not only effectively controls the flow split to the secondary cyclone, but also solves the wear problem in the transition zone, associated with earlier designs.

By reducing the turbulence in the transition zone, the bypass of coarse particles to the overflow of the secondary cyclone is minimised.

An added benefit of this reduced turbulence (and its associated pressure drop), is that the ReCyclone can be operated at similar pressure drops to conventional cyclones.

Applications

Principal applications of the ReCyclone are:

1. Grinding-classification circuits in which the circuit capacity can increase by more than 10%.

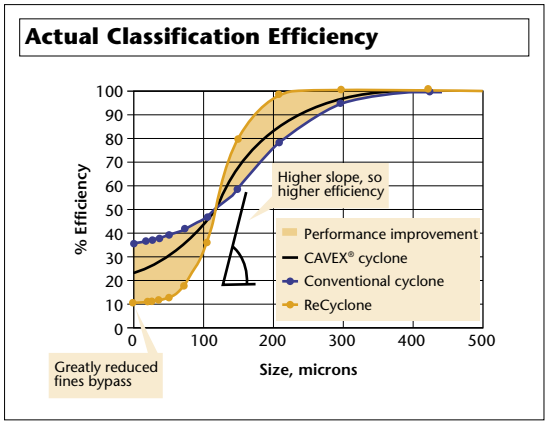
   In a milling circuit, the ReCyclone's higher classification efficiency and reduced fines bypass mean that fewer particles that are already fine enough, will report to the underflow and back to the mill.

   The ReCyclone thus minimises over-grinding. This is particularly critical in flotation circuits where over-grinding decreases mineral recovery.

   With the ReCyclone, the removal of fines from the circuit is maximised and this frees up additional capacity in the mill. This translates into:

- increased circuit capacity for the same grind, OR
- finer grind at the same circuit throughput

The improved ReCyclone classification efficiency is shown in the following partition curve.



Wash water feed line into the ReCyclone, complete with control valve, flow meter and pressure gauge.

A further benefit is that the ReCyclone cone can be adjusted "on-the-run" for fine-tuning of the split to the secondary cyclone - there is no need to stop the plant to change spigots.

2. Tailing dams

   The ReCyclone minimise the fines content for the safe construction of slimes dam walls. It also produces an underflow with a high solids content.

Air core booster

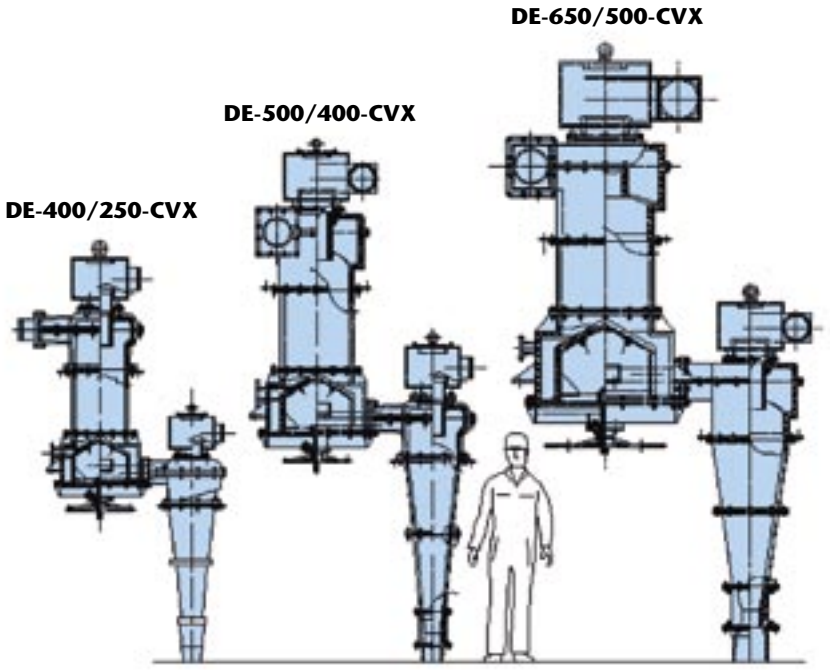
Air core boosters

An Air core booster can be fitted to the ReCyclone. This reduces turbulence in the overflow stream which in turn decreases the pressure drop. A stable and large diameter air core is produced which increases capacity, reduces fines bypass, and improves classification efficiency.

In summary, the ReCyclone:

- greatly improves classification efficiency
- significantly reduces fines bypass
- increases capacity of milling circuits
- minimises fines content in flotation feed
- minimises fines content for the safe construction of tailings dams
- reduces operating costs (no pump required, reduced wear in transition zone etc)

ReCyclone sizes available



Weir Minerals are specialists in delivering and supporting slurry equipment solutions including pumps, hydrocyclones, valves and wear resistant linings for global mining and minerals processing, the power sector and general industry

Weir Minerals has an advanced product range incorporating market leading brands covering virtually any application, in any environment.

Our global leadership in slurry pumps is combined with innovative designs in complimentary products such as slurry valves, hydrocyclones and wear resistant linings.

The Weir Minerals Brands:

ENVIROTECH®
Centrifugal Slurry Pumps

GEHO®
PD Slurry Pumps

CAVEX®
Hydrocyclones

ISOGATE®
Slurry Valves

VULCO®
Wear Resistant Linings

Geographical Footprint

Weir Minerals has the geographical presence to service all the major minerals markets around the world. This global supply capability provides a competitive advantage in this relatively fragmented market.

Customer Profile

Our customers range from the world's largest minerals and mining multinationals to single site coal producers.

Weir Minerals capability supports an array of customer specifications with products easily adaptable to meet specific process requirements. We build close, long term partnerships through which we are able to help customers achieve process efficiencies.

Weir Minerals customers include:

- Alcoa
- Anglo-American
- Barrick
- BHP-Billiton
- Codelco
- CVRD
- De Beers
- Grupo Mexico
- Newmont
- RTZ
- WMC

We support customer operations worldwide with consistent products and local engineering expertise. As part of the Weir Group, we have the reach and resource to build close, long term relationships with all our customers, helping them to achieve ...

The Lowest Cost of Ownership

ENVIROTECH® Centrifugal Slurry Pumps | GEHO® PD Slurry Pumps | CAVEX® Hydrocyclones | ISOGATE® Slurry Valves | VULCO® Wear Resistant Linings

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